USDA FOREST SERVICE

Research Note NC-202

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE — U.S. DEPARTMENT OF AGRICULTURE

Folwell Avenue, St. Paul, Minnesota 55108

1976

RELEASE ACCELERATES GROWTH OF YELLOW-POPLAR--

AN 18-YEAR LOOK

Robert D. Williams, *Principal Silviculturist*
Bedford, Indiana

ABSTRACT.--Yellow-poplar seedlings that germinated and were completely released from woody competition in 1957 (the first year after a harvest cut) were four times taller and five times larger in diameter after the 1973 growing season than seedlings that were not released.

OXFORD: 236.1:231:231.331:176.1 *Liriodendron tulipifera*. KEY WORDS: *Liriodendron tulipifera* L., germination date, seedbed scarification, natural regeneration, harvest cutting method.

Yellow-poplar (*Liriodendron tulipifera* L.) reproduction is usually abundant immediately after harvest cuts if seed is adequate. However, yellow-poplar will not grow well in the new stand unless the environment is favorable.

Results from a study in southern Indiana show that young yellow-poplar trees will survive under a high overstory but grow much faster if released. So if yellow-poplar is wanted in the new forest, stands containing yellow-poplar should be clearcut when harvested. Residual trees larger than 5 feet tall should be cut or killed.

METHODS

The study was conducted in a mixed hardwood stand on the Hoosier National Forest near Oriole, Indiana. The area is a broad ridge on Zanesville soil that has a site index of 60 for black oak and 70 for yellow-poplar. A harvest cut in the fall of 1956 reduced basal area from about 100 to 40 square feet per acre. The area had been heavily seeded by nearby yellow-poplar seed trees, and in the spring of 1957, about 10,000 yellow-poplar seedlings per acre were counted in the study area.

In July 1957, twelve 0.1 acre plots were established to find out how overhead release would affect survival and development of the new seedlings. Three intensities of release were tried:

1. Complete release--all woody vegetation over 5 feet tall was cut or frill girdled and poisoned, leaving a basal area of 0.

2. High release--all residual trees larger than 6 inches d.b.h. were cut or girdled and poisoned. Residual basal area of trees less than 6 inches was about 17 square feet per acre.

3. Check--no release, other than the timber harvest made in the fall of 1956, which left about 40 square feet of basal area per acre, mostly in cull and nonmerchantable trees. Normally, cull trees are girdled and poisoned following harvest cuts.

The three treatments were replicated four times. Reproduction was sampled in six

permanent, randomly located, circular, milacre "quadrats" in each plot. Each of the 72 "quadrats" was established at least 20 feet from the plot boundaries.

When the initial germination counts were made in July 1957, three seedbed conditions were recognized: (1) undisturbed litter, (2) scarified organic matter (usually strips along skid trails and around stumps), and (3) mineral soil (usually skid trails and loading areas). Each "quadrat" was diagrammed to show seedbed condition classes and slash accumulation.

Yellow-poplar stocking on the 72 "quadrats" averaged more than 10,000 seedlings per acre in July. Seedling distribution varied, however, according to ground scarification and slash accumulation, from 0 to 61 seedlings per "quadrat." When the "quadrats" were remeasured in September 1957, 88 percent of them contained at least one yellow-poplar seedling and 74 percent were stocked with more than one. The largest number of yellow-poplar seedlings germinated the first year after the harvest cut. But a substantial number germinated the second year and several germinated as late as the fifth year after the cut (table 1). In the spring of 1959, 78 percent of the "quadrats" were stocked with at least one seedling that germinated in 1958. And in the spring of 1962, 49 percent of the "quadrats" were stocked with one or more seedlings that germinated between 1959 and 1961.

Table 1.--*Yellow-poplar seedlings per acre by release treatment and the year germinated*

(In numbers)

Year seed germinated	Years after harvest cut	Release treatment		
		Check	High	Complete
1957	1	7,583	13,500	10,750
1958	2	7,875	6,668	3,208
1959-1961	3-5	3,125	1,792	1,582

RESULTS

Survival.--Eighteen-year results show that yellow-poplar seedlings that germinate immediately after logging have a much better chance of becoming established in the new stand than seedlings that germinate later, even if only 1 year later (table 2). Although survival of the 1957 seedling crop seems low, there are still about 1,100, 1,800, and 1,100 trees per acre remaining in the check, high release, and complete release plots, respectively.

Table 2.--*Survival of yellow-poplar seedlings at 18 years by release treatment and year the seed germinated*

(In percent)

Year seed germinated	Release treatment		
	Check	High	Complete
1957	14	13	10
1958	7	4	4
1959-1961	7	0	3

Late germinators survived best in the unreleased plots. During the winter of 1958-1959 more than 20 percent of the mortality on the released plots was caused by mice, while no mouse damage was found on the unreleased plots. Apparently, the heavier ground cover of grass, herbs, and slash on the released plots provided a better habitat for mice than the more sparse ground cover on the unreleased plots.

Scarification greatly affected initial germination. When the study was established in 1957, three-quarters of the seedlings were found on the disturbed forest floor[1/] (scarified organic matter and mineral soil) which made up only a little more than one-quarter of the area (table 3). However, degree of scarification had no effect on long-term survival; 18 years after the harvest cut survival of the 1957 seedling crop was 14 percent in the undisturbed litter, 13 percent in the scarified organic, and 14 percent in the mineral soil.

Table 3.--*Initial surface condition classes and distribution of yellow-poplar seedlings*

Seedbed	Area	Number of seedlings	Seedlings per acre
	Percent	*Percent*	*Number*
Undisturbed	73	23	3,200
Scarified	17	50	30,900
Mineral	10	27	27,200
Total	100	100	

1/ Engle, LaMont G. and Robert D. Williams. 1957. Scarifying seedbed boosts yellow-poplar germination. USDA For. Serv., Cent. States For. Exp. Stn. Stn. Note 110, 2 p.

"Quadrats" stocked with one or more seedlings, regardless of year germinated, decreased from 92 percent to 62 percent from the 5th to the 18th year. Nevertheless, yellow-poplar remains a major component of the new stand. Thirty-one percent of the trees on the check plots and 40 percent of those on both the high and complete release plots are yellow-poplar. And if present, yellow-poplar is the tallest species on 67 percent of the check plot "quadrats," 81 percent of the high release "quadrats," and 75 percent of the complete release "quadrats."

Growth.--Eighteen years after the harvest cut, the tallest 1957 trees in the complete release plots are more than four times taller than the 1957 trees in the check plots (table 4). Also, the tallest yellow-poplar trees of those that germinated the first year after the harvest cut are more than twice as tall as the tallest of those that germinated only 1 year later, regardless of release treatment.

Eighteen years after the cut, 38 of the 72 "quadrats" contained at least 1 yellow-poplar from the 1957 crop. Only 1 of these 38 "quadrats" contained a later germinator that was taller than the 1957 tree.

Degree of scarification had little effect on height growth. Height of the tallest yellow-poplar in each ground condition class averaged 19 feet for the undisturbed litter, 18 feet for the scarified organic, and 16 feet for the mineral soil.

Table 4.--*Mean height of tallest yellow-poplar per "quadrat" by release treatment and age of the tree 18 years after the harvest cut*

Year seed germinated	Tree age	Release treatment		
		Check	High	Complete
		Feet		
1957	17	6.1	14.8	25.0
1958	16	2.7	4.6	10.4
1959-1961	13-15	1.4	--	0.4
1962-1973	1-12	3.5	--	--

Diameter growth was increased by release, too. Mean diameter of the largest trees in the complete release plots is about five times greater than that of the largest trees in the check plots (fig. 1). Mean d.b.h. of the largest yellow-poplar per quadrat is 0.5 inch in the check plots, 1.1 inch in the high release, and 2.7 inches in the complete release.

CONCLUSIONS

Eighteen years after a timber harvest, several facts concerning the reproduction, survival, and growth of yellow-poplar are evident:

Figure 1.--*Completely released yellow-poplar (left) are typically much larger than unreleased trees (right) that survive under an overstory*

1. Yellow-poplar germinates best on a scarified seedbed, but neither survival nor growth are dependent on the degree of scarification.

2. Yellow-poplar will survive under a partial overstory (40 sq. ft. of basal area), but growth is very slow. Trees completely released are four times taller and five times larger in diameter than unreleased trees.

3. Although there is no difference in survival between high release trees and completely released trees, the difference in growth is notable. Completely released trees are almost twice as tall and their diameter is more than twice that of the high release trees.

4. Yellow-poplar competes well with other species, especially in openings. Yellow-poplar has a better than average chance of being taller than its neighbor under a partial overstory, but if released, yellow-poplar may be taller than its neighbor 75 percent of the time.

5. Yellow-poplar that germinated the first growing season after a cut has a much better chance of becoming established in the new stand.

6. Yellow-poplar seedlings can be released, but the cheapest way to favor yellow-poplar in the new stand, when seed trees are nearby, is to completely clear the regeneration area when the old stand is harvested. Because viable yellow-poplar seed accumulates in the litter, the seed trees may be cut when the rest of the stand is harvested.2/

2/ Clark, F. Bryan and Stephen G. Boyce. 1964. Yellow-poplar seed remains viable in the forest litter. J. For. 62(8): 564-568, illus.

☆U. S. GOVERNMENT PRINTING OFFICE: 669099/115 REGION NO. 6